RDT

Brief

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Application of Sand Anti-Fracture (SAF) Layer for Pavement Rehabilitation

Research Development and Technology Division

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Project Description:

The sand anti-fracture (SAF) layer is a fine graded asphalt mix containing highly polymerized asphalt binder placed between an existing pavement and an asphaltic concrete overlay as a means of pavement rehabilitation. SAF mix has higher voids in the mineral aggregate (VMA), higher asphalt binder content, and lower air voids than conventional asphalt mix. High polymer content enables the SAF mix to resist more pavement strains than conventional asphalt concrete (AC). Compacted SAF mix can withstand approximately 4.5 times higher strain without cracking at one million loading cycles in the SHRP four-point beam fatigue test. An SAF layer is supposed to inhibit the horizontal tensile strains at the bottom of an overlay that cause reflective cracking.

An SAF layer was constructed on two separate projects in northwest Missouri. The first project was built in 1998 on I-29 in Holt County. The project included eight test sections, which contained variables for degree of pavement repair, overlay thickness, grade of asphalt, and presence of the SAF layer. Figure 1 illustrates the project's eight test sections. The SAF layer is being evaluated in this investigation for resistance to reflective cracking, possible reductions in PCC pavement repairs, and reductions of overlay thickness.

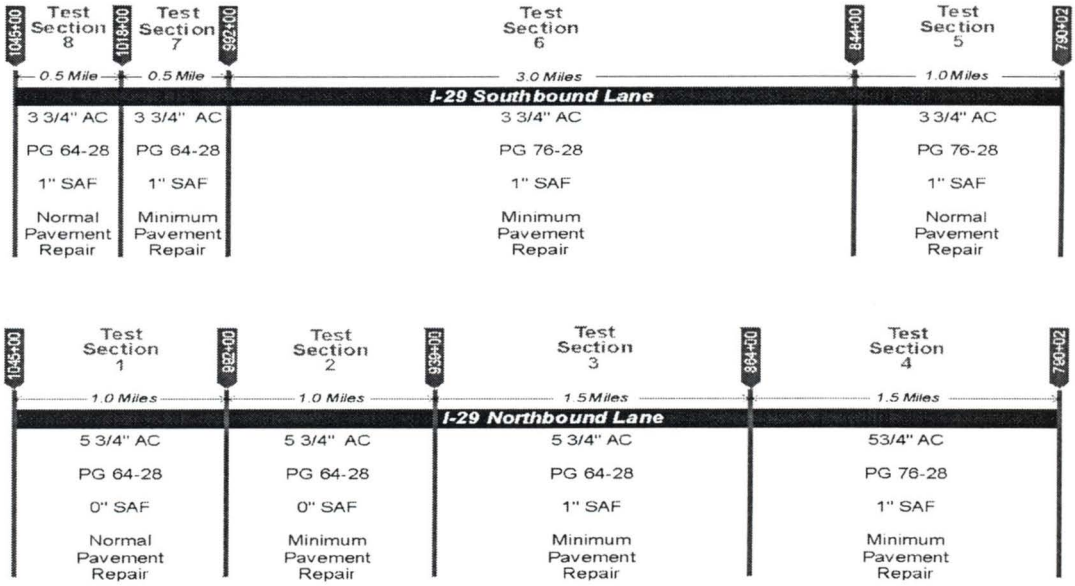

Figure 1 – Route I-29 Test Section Layout

Another project was constructed in June 2000 on the eastbound lane of U.S. 36 in DeKalb County. This project included two test sections. One test section has a 1-inch SAF layer under the AC overlay. The other is a control section that contains an AC overlay without the SAF layer. These two test sections will be compared to evaluate the SAF's effectiveness to reduce reflective cracking, lower the maintenance costs, and extend the service life of the pavement.

Project Construction:

On the I-29 project, the SAF was placed over an existing 9-inch, 1974 PCC pavement that showed significant joint deterioration and D-cracking. The main construction challenge was controlling the proper flow rate and temperature of the highly polymer binder during the SAF mixing. The results of uncontrolled asphalt led to poor workability, significant rutting, and difficulties in compacting and unloading from trucks. Once the proper temperature of the asphalt binder was established, the proper flow rate of asphalt binder could be maintained. Consequently, the occurrence of pavement rutting diminished, and placement and workability problems were improved. Despite some initial problems during the construction, the finished product seemed to be a success. The eight test sections will be monitored and compared annually for a minimum of 5 years or until the SAF layer's effectiveness in reducing reflective cracks is determined.

The rehabilitation on U.S. 36 consisted of placement of the SAF layer over an existing AC/PCC pavement. The original 1927, 6-inch PCCP was overlaid with asphalt in 1952, 1967, and in 1983. A 1-inch SAF layer was placed on the existing pavement surface before constructing a 3 ¾-inch SuperPave overlay. Most of the construction issues that occurred on the I-29 project did not occur on the U.S. 36 project. There was no significant rutting and the workability was good. Trucks unloaded the SAF material with few difficulties. One challenge was controlling and maintaining an adequate mix temperature. There were unexplained spikes and dips in the temperature ranges that might have contributed to the tearing appearance in the SAF mat. However, after compaction the SAF mat was smooth and stable.

Project Research:

Project research for both the I-29 and U.S. 36 projects consist of annual field testing which includes, but is not limited to, the following:

- Visual distress surveys
- Rutting measurements
- Falling weight deflectometer testing (FWD)
- Coring
- Collection of ARAN data

Each of the field tests will be conducted annually on each test section. RD&T will monitor the U.S. 36 and I-29 SAF projects annually for a minimum of 5 years. Further monitoring will be dependent on pavement performance. The effectiveness of the SAF layer in reducing reflective cracking will be compared to MoDOT's conventional overlays. Also, the SAF's effectiveness of extending the service life of the overlay will be projected. Finally, a cost-savings from using the SAF layer will be estimated provided there is lower maintenance of sealing cracks and an extended overlay life.

Initial Construction Costs:

The costs of the SAF material for both projects are listed in Table 1. The increase in SAF cost between the two projects is probably due to the surge of crude oil prices in the United States in 2000. A life cycle cost analysis will be necessary to prove any monetary savings from lower maintenance costs and extended pavement life. Currently, no conclusions can be made on the effectiveness of the SAF to decreased maintenance costs and extended AC overlay life. A cost analysis will need to be performed to determine the SAF as an economical means of pavement rehabilitation.

Project	Cost per yd^2	Cost per lane mile
Route I-29	$2.97	$21,000
U.S. 36	$4.81	$34,000

Table 1 – Cost of SAF Mix

Initial Conclusions:

Regarding construction and placement, the SAF layer proved to be a workable and very stable mix as long as the binder temperature, mix temperature, and binder flow rate was controlled. Though, from a design aspect, some limitations of the SAF have been realized. Despite the SAF initially endorsed as a method of reducing pavement repairs and AC overlay thickness, more recent SAF application is promoted to simply retard reflective cracking in areas of existing minor to moderate surface distress. The SAF layer has a lower structural value compared to a conventional asphalt mix. Therefore, its placement cannot justify reducing the overlay thickness and it should not be used as an alternative to full-depth PCC pavement repair. Use of the SAF layer could realize a reduction in pavement repairs only if minor to moderate surface distresses are included in the pavement repair estimations. However, MoDOT does not repair minor to moderate surface defects, since structural AC overlays should mitigate these problems.

Based upon current field data and observations, no conclusions of the SAF layer's effectiveness in reducing reflective cracking can be made. Further testing and monitoring of the test sections on both the I-29 and U.S. 36 projects is needed in order to validate the SAF technology as an effective and economical solution for pavement rehabilitation.

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